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SUBJECT: Air washer structure and function observed\* at a Du Pont  
Nylon Plant at Seaford, Delaware

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TO: Mr. James G. Touhey  
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BACKGROUND

Prior to the formation of the American Society for Testing and Materials (A.S.T.M.) E-35 Pesticide Committee, January 18, 1973, a series of conferences between EPA and an Ad Hoc Industry Advisory Group was successful in preparing a guide to claims and labeling and efficacy data requirements for algicides and slimicides used in cooling water. This document is intended to address microbial control problems of recirculating cooling systems, including air washers. However, estimation of potential human hazard(s) incurred by breathing "washed air" treated with water containing possible entrained microbes from air washing devices requires special consideration. During one of the EPA-Industry Conferences, Dr. Fred Wilkes, Dearborn Chemical Company, presented an illustrated talk on air washers; Dr. Bernard Shema, Betz Laboratories, distributed diagrams of various devices that employ water to cool, clean and regulate relative humidities. A typical diagram is attached.

Industry representatives, both pesticide producers and users, are very reluctant to describe, define, or estimate any present or potential human hazards associated with air washing devices. Attempts by concerned EPA personnel to arrange inspection visits of operating air washers have been unsuccessful. The attached memorandum by Dr. David Greenman, former EPA Toxicologist, resulted in:

1. continuation of those microbicides already registered for use in air washers, and
2. a decision not to register new chemicals for use in air washers.

Dr. Greenman's memo explains that guidelines for estimating human hazards must be deferred pending acquisition of more air washer knowledge. Re-registration of already accepted products and applications now on hand for use of new pesticide chemicals in air washers indicates that this problem should be resolved in the near future.

Dr. Orville Paynter, Chief, Toxicology Branch, R.D., suggested that specific toxicology needs include a description of the expected life of the "mist eliminators" (droplet removers) on these devices, and how efficient is this equipment in removing droplets from air washer treated air.

Recently, Dr. Bernard Shema offered to try to arrange an inspection tour of industrial air washers in a large Du Pont Nylon plant for William Campbell and William Woodrow, EEEB. Dr. Shema's efforts on our behalf were successful.

#### TRIP REPORT

Dr. Bernard Shema, Betz Laboratories, Philadelphia, Pa., and Mr. Donald Vassel, Betz Baltimore Representative, accompanied William Campbell and William Woodrow, Efficacy Section, EEEB, on a one day tour of industrial air washer systems at a Du Pont Nylon Manufacturing Plant located at Seaford, Delaware, May 14, 1975.

As outlined above, the purpose of this inspection tour was to try to obtain a working knowledge of air washers that would provide a means for C.&E.D. and R.D. personnel to estimate potential human hazard(s) associated with air washer use; also to prepare guidelines for registration of microbicides used in air washers.

Prior to our arrival at the Nylon Plant, Dr. Shema told us that we could not expect to view the Nylon manufacturing process; apparently visible parts of the process involve trade secrets.

Before leaving an office complex at the Du Pont Nylon plant to view functioning air washers, Mr. Royce Trauth, Power House Supervisor, and other plant officials, questioned us rather closely about the exact purpose of our visit. When we explained that our air washer knowledge only consisted of two dimensional diagrams and verbal descriptions, and that no one at our EPA offices had seen an air washer, they seemed to understand. We also mentioned that it is difficult for people responsible for regulating the use of pesticide chemicals to properly function without at least viewing systems in operation in which such chemicals are used. Using a large flow diagram Du Pont Company officials outlined air washer structure and function.

This explanation immediately changed one of our concepts concerning air washers; that air washers in fact, are employed to provide air at very critical temperatures and relative humidities for manufacturing processes. We had wrongly believed that an air washer's primary purpose was to scrub air to remove suspended particles and finely divided material prior to plant personnel exposure.

We left the Nylon plant office complex and climbed stairs to the top (third) floor of the plant itself. Three "built up", very large air washing systems were positioned over Nylon "spinning" rooms below, which we were not allowed to visit. Two of these air washer units were in operation while the third was on standby. Engineers design large "built up" air washers, whose component parts may be obtained from various sources, while the plant also utilizes several "package" air washers purchased as single units. The smaller package units serve product packing and other enclosed areas in the plant. Apparently, the only distinction between "built up" and "package" air washers is simply that intact packaged units are not available above certain sizes. Both types of air washers introduce air of controlled humidity and temperature into different kinds of Nylon manufacturing areas where people who work in these areas may be exposed to volatile chemicals contained in the water used to treat the air.

Please examine the attached diagram of a typical air washer system furnished by the Betz Company. A diagrammatic scheme of the structure and function of the Nylon plant air washers we viewed at Seaford, Delaware, follows:

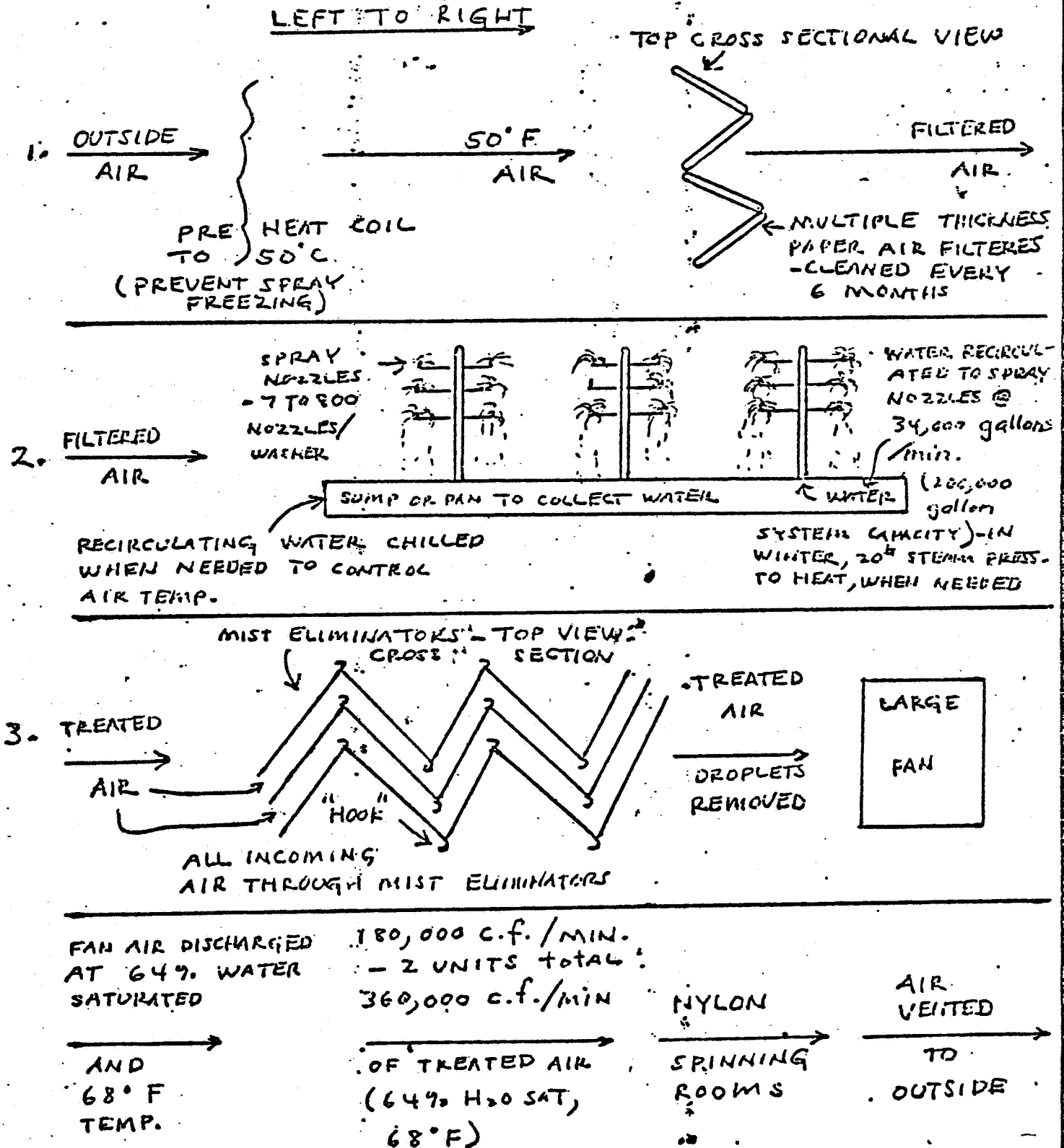
Two operating air washers deliver 360,000 cfm of treated air to approximately 2,000,000 c feet of Nylon spinning room area. Thirty-four gallons of water per minute are recirculated from the air washer sump back to the water spray nozzles, and 15 gallons per minute of make up water are added to the sump to compensate for water evaporation.

Most cooling systems require a "blow down" of part of the recirculating water to reduce cycles of concentration of constantly accumulating air borne metal salts and foreign organic matter. There is no blow down system in use on the air washers we viewed; the air filtering systems remove so much foreign matter that the systems are only partially cleaned once per year, and thoroughly cleaned on alternate years. Lack of sunlight precludes the growth of algae in these systems. Fungus growth is very minimal. The only microbial growth problem that requires control in the systems we inspected was bacterial; a slime does form and accumulate on water contact surfaces composed of 50% bacteria and 50% iron deposit. The bacteria recovered from these slimes are mostly gram negative. Klebsiella sp., Bacillus mycoides or B. subtilis, and Flavobacterium sp.

The air washer recirculating water is not chlorinated to reduce microorganisms because of chlorine odor and its corrosiveness. We had agreed prior to visiting the Nylon plant that we would not press questions about water treatment. After the tour Dr. Shema told us in private that the microbial control chemicals employed in the air washer systems we inspected were a combination surfactant to reduce foaming in the sump plus quaternary ammonium compounds to control bacterial growth. No mention

was made of dosage rates and we assumed that maintenance personnel were treating the systems according to product labels.

A diagrammatic scheme of the air washer system, including mist eliminator cross section details we viewed at Seaford, Delaware, follows:




All air exposed to water spray passes through the mist eliminators. We were told that the "hooks" occurring at exposed angles within the eliminators were very efficient in removing water droplets.

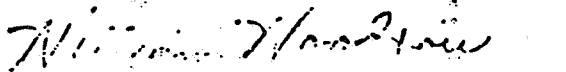
The air washer system we viewed was exceptionally clean, and appeared to function as we were told it was supposed to. Of course, there are probably air washer systems that are marginal in function and perhaps require excessive amounts of microbicide treatment, however, the success of industrial operations, requiring the use of air washers in plant processes would indicate that such systems quite probably receive adequate attention to insure economic success.

A number of questions remain to be answered before toxicity data requirements for use of microbicides in air washing devices can be outlined, such as:

1. Range of water droplet sizes produced by spray nozzles.
2. Average effectiveness of mist eliminators in removing water droplets.
3. Average elapsed time between air washer cleanings.
4. Possibility of dissemination of potentially pathogenic bacteria contained in recirculating air washer/cooling system water sources.
5. Since amount of make up water will depend to a large extent on ambient relative humidity, we will need to know average ranges of make up water volumes during winter and summer seasons.

The answers to these questions plus provision of other pertinent information is currently being assembled by Dr. Bernard Shema and his staff, Betz Laboratories.

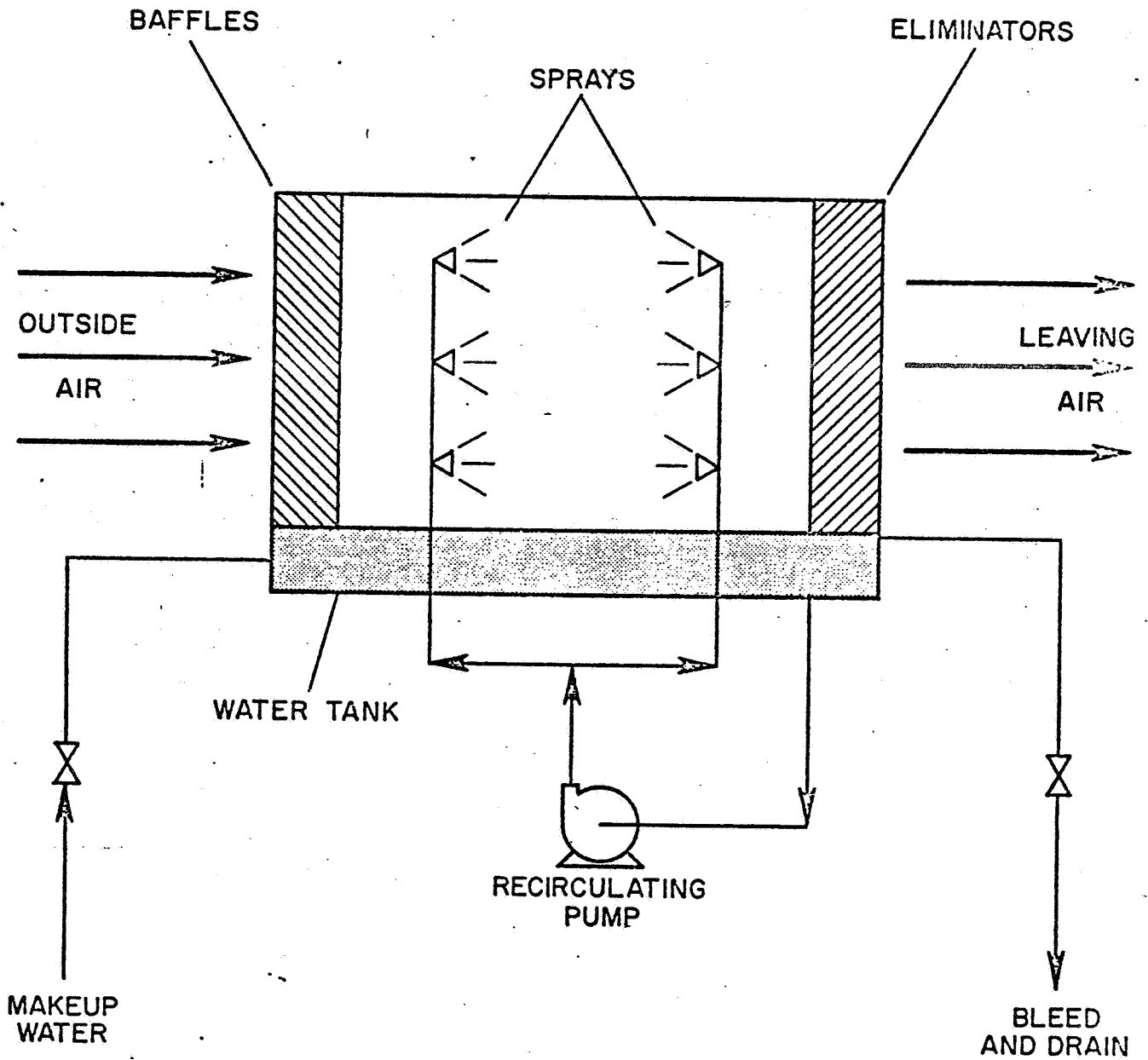
  
William Campbell

  
William Woodrow, Ph.D.

7/9/75

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ENGINEERING DRAWING



			SPRAY-TYPE AIR WASHER SCHEMATIC DIAGRAM	
DRAFTSMAN <i>Schmitt</i>	ENGINEERING APPROVAL <i>R.L.R.</i>	CERTIFIED BY	SCALE <i>NONE</i>	REFERENCE NUMBER
SHEET CODE	DATE			